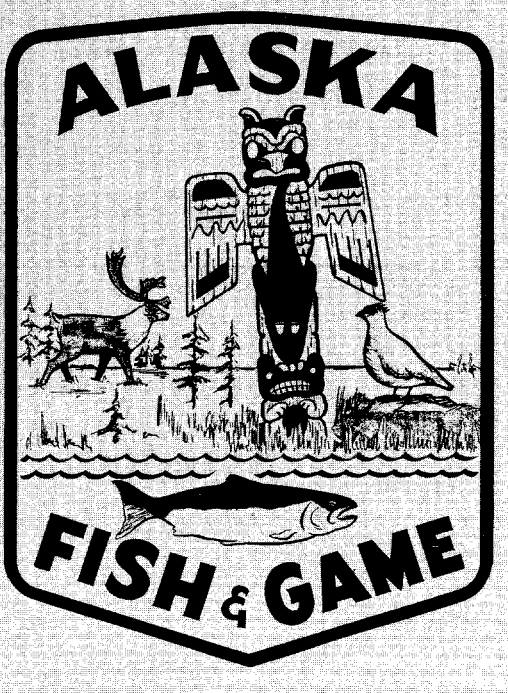
Informational Leaflet 150

FORECAST OF THE 1971 KODIAK AREA PINK SALMON RUN

By:

Kenneth R. Manthey
Division of Commercial Fisheries
Research Section
Kodiak, Alaska

March 26, 1971



STATE OF ALASKA
[redacted] · GOVERNOR
William A. Egan
DEPARTMENT OF
FISH AND GAME

SUBPORT BUILDING, JUNEAU 99801

TABLE OF CONTENTS

FORECAST OF THE 1971 KODIAK AREA PINK SALMON RUN

By

Kenneth R. Manthey, Fishery Biologist
Alaska Department of Fish and Game
Division of Commercial Fisheries
Research Section
Kodiak, Alaska

INTRODUCTION

This report constitutes the sixth annual forecast publication on pink salmon (Oncorhynchus gorbuscha) in the Kodiak Area. The main objective of this study is to forecast the 1971 pink salmon run well in advance of the actual return. This should allow fishermen and processors ample time to gear operations for a relatively efficient harvest and give fishery management personnel time to formulate management policy.

Pink salmon live only two years from the time of egg deposition to the subsequent return of the adults to spawn. Since there is no overlapping of generations as in the other four Pacific salmon species, the even and odd year populations of pink salmon remain distinct stocks. For the past 23 years the even-year cycle has been dominant in the Kodiak Area.

Pink salmon eggs and fry experience highly variable over-winter mortality due to dessication, erosion, asphyxiation, freezing etc. Pre-emergent fry sampling conducted in the spring (March and April), after major fresh water mortality factors have occurred is currently the best method of forecasting the abundance of pink salmon.

Seven years of pre-emergent fry data have been collected for the Kodiak Area (excluding the Mainland District). Three years of pre-emergent fry data are available for the odd-year cycle. Recently (1967 and 1969), the odd-year adult return has shown considerable deviation from the 5.9 million average odd-year return since 1953. This report presents the estimated 1971 pink salmon return based on pre-emergent fry abundance.

METHODS

Sampling Equipment and Procedures

In the spring of 1970, 23 index streams were chosen for pre-emergent fry sampling in the Kodiak Area. The sampled streams are reached primarily by chartered helicopter.

Pink salmon fry sampling methods and materials have been described recently by Smedley, et al (1968) and Edfelt (1970). Briefly, the technique employs a specially mounted Homelite pump which forces a mixture of water and air through a probe into the streambed within the confines of a circular collection frame. Light materials, including eggs and fry, are bubbled up out of the gravel and washed into a tapered net attached to the downstream side of the collection frame. By removing a binder clamp at the cod end of the net, the eggs and fry are released into a plastic pan for counting.

The bulky collection frames were made collapsible prior to the 1970 pre-emergent fry sampling season, resulting in a more efficient use of space within the helicopter (Manthey, 1970).

Forecast Methods

Pre-emergent fry sampling results in an estimated average number of fry per unit area for each index stream and for all index streams combined. These data can then be compared with pink salmon fry data from past years from which the total subsequent adult returns are known. The total adult return is the sum of peak escapement counts from aerial surveys on 37 escapement index streams, plus the commercial catch.

The 23 streams chosen for pink salmon pre-emergent fry sampling in 1970 received 60% of the total 1969 Kodiak Area escapement (excluding the Mainland District).

The sampling sites within each index stream were chosen in areas where most of the pink salmon have spawned. These major spawning areas have remained substantially the same through all years of pre-emergent fry sampling.

Primarily Fisheries Research Institute aerial peak escapement counts by a standard observer have been used in previous forecast publications for the Kodiak Area. Several important pink salmon producing streams were not surveyed by the Fisheries Research Institute in 1970. Most of the remaining

streams were flown on two separate occasions, but inclement weather caused poor stream visibility during at least one of these surveys. Therefore, all 1970 escapement counts have been reported from Alaska Department of Fish and Game observations (Appendix A).

Edfelt (1970) used two methods to develop the 1970 forecast to the Kodiak Area. Both of these methods will again be used to develop the 1971 pink salmon forecast.

Method (1) involves a simple ratio calculation using the fry density to adult return for the parent year cycle to the fry density for comparable streams sampled in the forecast year. This method of comparing the parent year fry density and subsequent adult return to the forecast year density may also be used to arrive at district estimates.

Method (2) utilizes all years of pre-emergent fry-adult return data available. A regression analysis of the data is then used to fit a line to the fry-adult return data. The 1971 pink salmon return is forecast from the 1970 pre-emergent fry index plotted on the fitted line.

All years of pink salmon pre-emergent fry data for all streams sampled have been used in Method (2). The number of streams sampled each year has varied from 18 to 31 and only 12 streams have been sampled every year (Appendix C and D). Because of the small number of streams sampled every year, the same stream base has not been used in Method (2). An attempt is being made to derive a fixed set of index streams to be used in developing future pink salmon forecasts.

RESULTS AND DISCUSSION

Kodiak Area Forecast

Fry density data from 21 of the 23 streams sampled in 1970 are comparable to the 1968 stream sampling densities. Two streams (Hurst and Kiliuda), were not sampled in 1968. The parent year 1968 fry density for all streams sampled was $19.85/0.1m^2$. The 1970 fry density for 21 comparable streams was 36% lower at $12.74/0.1m^2$ (Table 1). Based on Method (1) the 1971 adult return is estimated at 8.48 million pink salmon as shown below.

$$\frac{\text{1968 fry density } (19.85/0.1m^2)}{\text{1969 adult return } (13,206,000)} = \frac{\text{1970 fry density } (12.74/0.1m^2}{\text{1971 adult return estimate}}$$

1971 adult return estimate = 8,475,000 pink salmon

Table 1. 1970 and 1968 Kodiak-Afognak Pre-emergent Fry Sampling Results.

Stream	YEAR 1970 No. 2 ft² samples	1970 No. fry	1970 Density 0.1m² 1/	1968 No. 2 ft² samples	1968 No. fry	1968 Density 0.1m² 1/
Portage Lake (upstream)	30	1,215	21.79	--	--	--
Portage Lake (downstream)	50	5,146	55.37	50	3,372	36.28
Paramanof Creek-304	50	26	0.28	65	0	0.00
Afognak River	70	55	0.42	40	0	0.00
Danger River	60	347	3.11	57	1,668	15.74
Sharatin (Elbow) Creek	50	854	9.19	50	626	6.74
Bauman's Creek	40	1,115	15.00	40	2,628	35.35
Terror River	70	92	0.71	70	53	.41
Uganik River	80	147	0.99	80	1,433	9.64
Zachar River	60	0	0.00	60	0	0.00
Uyak River	71	4,196	31.79	85	2,766	17.51
Dog Salmon River	90	812	4.85	90	4,257	25.45
Narrows Creek	50	1,142	12.29	50	2,092	22.51
Deadman River	80	5,085	34.20	80	5,994	40.31
Humpy River (upstream)	60	291	2.61	90	1,516	9.06
Humpy River (downstream)	60	1,377	12.35	60	6,330	56.76
Seven Rivers (Upper fork)	75	2,024	14.49	75	5,226	37.49
Seven Rivers (Lower fork)	70	6,180	47.49	70	5,429	41.73
Kaiugnak Creek	50	635	6.83	61	10,295	90.80
Barling River	60	401	3.60	50	124	1.33
Kiliuda River-207	50	757	8.15	--	--	--
Saltery River	80	503	3.38	85	1,205	7.63
Hurst Creek	60	1,117	10.02	--	--	--
Sid Old's River	80	2,695	18.12	90	1,699	10.16
American River	80	2,243	14.02	95	1,508	8.54
Buskin River	90	773	4.62	90	192	1.15
Totals 2/	1,526	36,139		1,583	58,413	
Density/0.1m² 3/			12.74			19.85

1/ Density computed in tenth square meters for comparative purposes with other areas.

2/ Total is for only the 21 streams which were sampled in both years.

3/ Density is computed from totals and is not an average of all densities listed. This results in a stream index weighting by stream sample size, the sample sizes being roughly proportional to relative stream productions.

Using all available years of pre-emergent fry data as described in Method (2), a line is fitted to the pre-emergent fry index-adult return data (Table 2 and Figure 1). The 1971 return calculated from the equation $Y = 0.58X + 0.42$ is estimated to be 7.77 million pink salmon. (It should be noted that an 80% confidence range of approximately 4.9 million would be associated with the regression estimate of 7.77 million.) If these two estimates derived from Method (1) and Method (2) are considered to be the range of the return, the mid-point estimate is 8.13 million pink salmon, more than 2 million higher than the odd-year average return since 1953.

A projected return for the Kodiak Area may be much more meaningful to the fishery manager and fishing industry if areas of expected strengths and weaknesses can be revealed. Assuming that the commercial fishing effort and catch pattern are similar to the parent year (1969), an estimated pink salmon return by district may be projected by using Method (1). District forecasts developed from this method cannot compensate for changes between years in rates of interception in the various fishing districts.

The 23 streams sampled in 1970 for the abundance of pre-emergent fry are located in the Afognak, Uganik, Uyak, Alitak and General districts (Figure 2). The Karluk, Sturgeon and Red River districts produce very few pink salmon on the odd-year cycle (Appendix B).

The Afognak district is expected to receive a return of 0.5 million pink salmon, which is similar to the 1969 parent year return (Table 3). Low fry densities were obtained for this district in both 1968 and 1970.

The fry densities obtained from the Uganik and Uyak districts were below that of the parent year in most streams. Large reductions occurred in Bauman's Creek and Uganik River. Uyak River should be the primary producer in this area for which the forecast is 0.7 million pink salmon.

The Karluk, Sturgeon and Red River districts do not support a pink salmon fishery on the odd-year cycle. Only a few incidental pinks may be taken in the red salmon fishery in this area.

In the Alitak district, fry densities were below the parent year densities in all streams sampled. A forecast of 1.9 million pink salmon is projected for this area and Deadman Bay should be the primary producer.

The General (Eastside) district, reaching from Monashka Bay to Cape Trinity, should produce 5.0 million pinks in 1971 and thus constitute the bulk of the fishery.

Table 2. Pre-emergent fry indices for all streams sampled and subsequent returns, 1963-70.

	Year of Pre-emergent Sampling/Year of Subsequent Adult Return						
	1963/64	1965/66	1966/67	1967/68	1968/69	1969/70	1970/71
No. streams sampled	19	20	18	30	21	31	23
Fry density/0.1m^2 all streams	17.80	15.98	5.95	15.31	19.85	29.23	12.64
Return equal to subsequent catch plus indexed escapement (millions)	13.34	11.48	0.68	9.61	13.20	14.11	

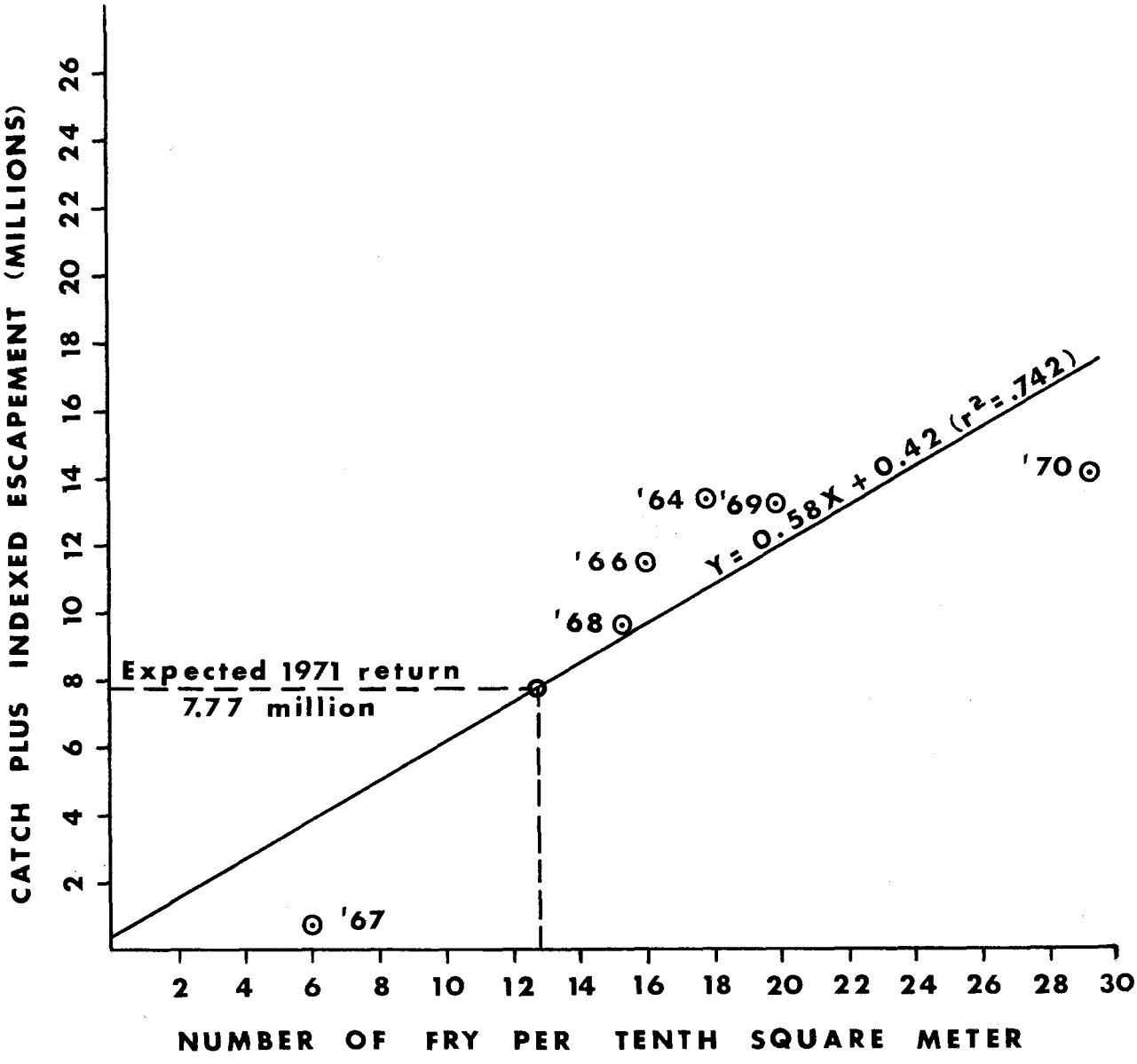


FIGURE 1.--Relationship between pre-emergent pink salmon fry densities 1963-1970 and subsequent return 1964-1971, Kodiak Area. Fry density data for the 1965 adult return is not available.

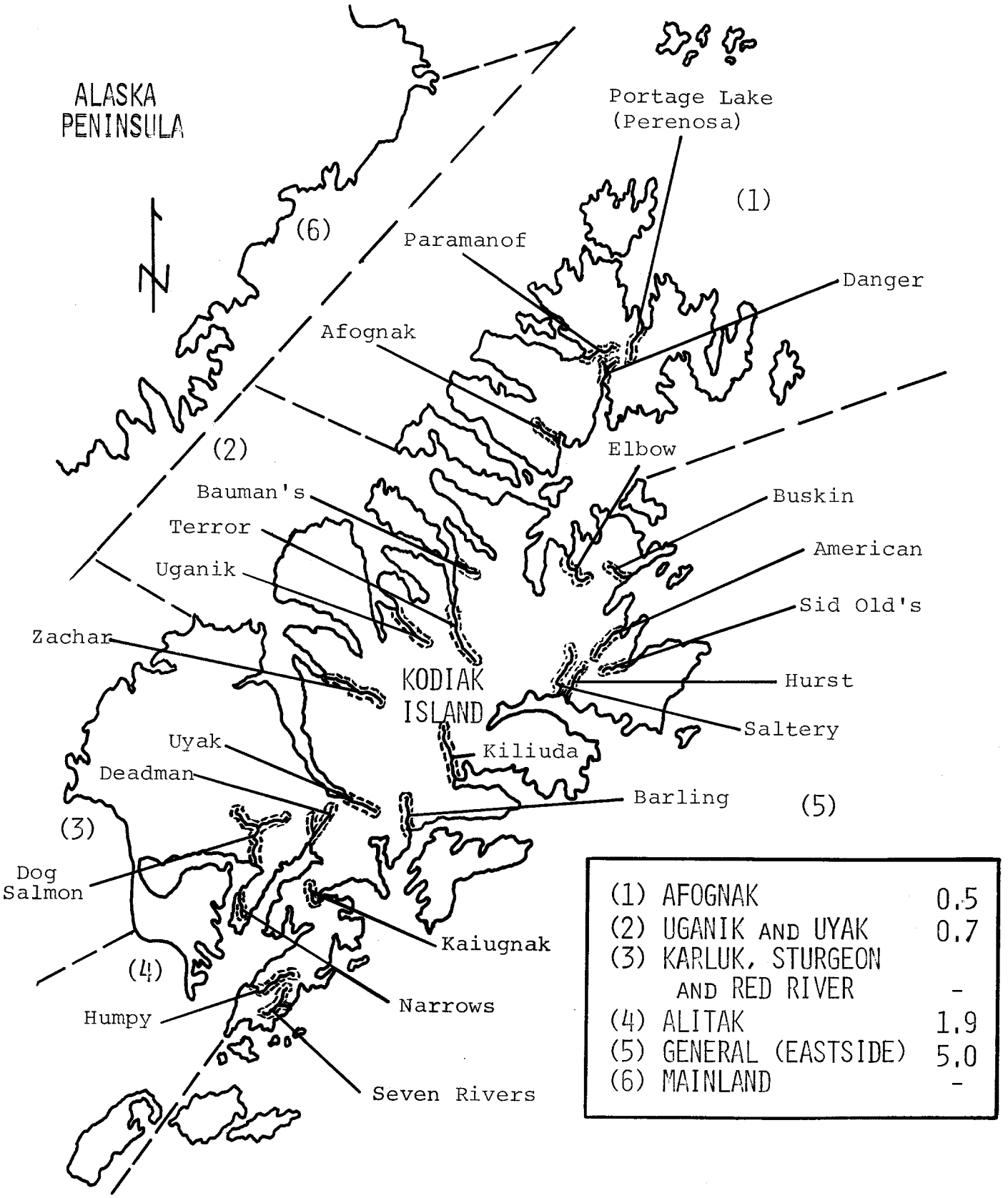


Figure 2. Kodiak Area odd-year cycle pre-emergent fry sampling streams and expected 1971 return by district (millions of pink salmon).

Table 3. Kodiak Area pink salmon, 1968 and 1970 fry sampling summary, density ratios and expected 1971 return by district.

District	Number streams sampled	1968			1970			Ratio 1970/1968	1969 return (millions)	Expected 1971 return (millions)
		No. samples	No. fry	Fry per sample	No. samples	No. fry	Fry per sample			
Afognak	5	262	5,666	21.6	280	6,428	23.0	1.06	.498	(.528)
Uganik and Uyak	5	335	6,880	20.5	321	5,550	17.3	.84	.875	(.735)
Karluk, Sturgeon and Red River	0	-	-	-	-	-	-	-	-	(-)
Alitak	4	370	20,189	54.6	340	8,707	25.6	.47	3.933	(1.849)
General	7	616	25,678	41.7	585	15,454	26.4	.63	7.900	(4.977)
Total	21								13.206	(8.089)

The summation of the district forecasts derived from Method (1) is 8.1 million pink salmon. The midpoint (8.13 million) of the forecast range derived from Method (1) and Method (2) is near the summation of the district forecasts.

Anticipated Commercial Harvest

An estimated escapement index of 1.3 million pink salmon is desired for the major pink salmon producing streams on the odd-year cycle for the Kodiak Area (excluding the Mainland district). Assuming that the 1971 pink salmon return is near the 8.1 million forecast, approximately 6.8 million pink salmon may be available for commercial harvest.

The primary objective of pink salmon management is to achieve optimum or desired spawning populations. Therefore, if the 1971 pink salmon return is smaller than forecast, stricter harvest regulations may be necessary to insure the desired escapement goal. By the same reasoning, a pink salmon return larger than forecast would allow relaxation of commercial fishing regulations, resulting in a larger commercial harvest.

Mainland District

The Mainland district of the Kodiak Area includes all Alaska Peninsula waters from Cape Douglas to Kilokak Rocks. Pre-emergent fry sampling is not conducted in this area and because of incomplete escapement data no escapement-return relationship has been developed. Therefore, no formal forecast will be presented for the Mainland district. The commercial catches from 1962-1970 have been presented in this report (Table 4). The 1969 (parent year) commercial catch was nearly double the 34,000 odd-year average commercial catch since 1962. The inconstant nature of the commercial catches for the Mainland district is due in part to the variability of the fishing effort in that area which precludes any projection of commercial harvest.

Table 4. Commercial pink salmon catch for Mainland district, Kodiak Area, 1962-1970.

	1962	1963	1964	1965	1966	1967	1968	1969	1970
Commercial catch 1/	1,188,000	5,000	605,000	65,000	301,000	1,000	378,000	66,000	284,000 2/

1/ From Kodiak Area Management annual reports.

2/ Preliminary

SUMMARY

Data derived from pre-emergent fry densities and the subsequent adult returns form the basis for this forecast.

Pre-emergent fry sampling is accomplished in the spring (March and April), after the major fresh water mortality factors have diminished and is currently the best method of indexing the abundance of pink salmon. In the spring of 1970, 23 streams were sampled hydraulically for the abundance of pre-emergent fry.

Two methods utilizing pre-emergent fry data were used to develop the 1971 forecast.

Method (1) yielded a 1971 adult return estimate of 8.48 million pink salmon. This method involves a simple ratio calculation using the fry density to return for 21 comparable streams sampled in 1968 and 1970.

Method (2) utilizes all years of pre-emergent fry-adult return data available. A regression of fry densities on return resulted in a 1971 adult return estimate of 7.77 million pink salmon.

If the two adult return estimates derived from Method (1) and Method (2) may be considered to be the range of the return, the midpoint estimate is 8.13 million pink salmon.

Assuming that the commercial fishing effort and catch pattern will be similar to the parent year (1969) an estimated adult return by district was developed using Method (1).

The Afognak district is expected to receive a return of 0.5 million pink salmon. An estimated 0.7 million pink salmon should return to the Uganik and Uyak districts. The Karluk, Sturgeon and Red River districts do not support a pink salmon fishery on the odd-year cycle. The Alitak district is expected to receive 1.9 million pink salmon and the General (Eastside) district should produce 5.0 million pink salmon and thus constitute the bulk of the fishery.

The summation of the district forecasts derived from Method (1) is 8.1 million pink salmon. The midpoint (8.13 million) of the forecast range derived from Method (1) and Method (2) is near the summation of the district forecasts.

No formal forecast is presented for the Mainland district. However, the commercial catches from 1962 to 1970 are presented.

Providing the actual 1971 pink salmon return for the Kodiak Area (excluding the Mainland district) is near the 8.1 million forecast, approximately 6.8 million pink salmon would be available for commercial harvest.

LITERATURE CITED

Alaska Department of Fish and Game, Kodiak Area Annual Mgmt. Reports, Manuscript Reports 1962-1969.

Edfelt, Larry B. 1970. Forecast of the 1970 Kodiak Area pink salmon run. Alaska Department of Fish and Game Informational Leaflet No. 141 14 p.

Manthey, Kenneth R. 1970. Modification of pink salmon alevin collection frames, in Report of the 1970 Northeast Pacific Pink Salmon Workshop, Charles E. Walker, Editor. 77 p.

Smedley, Stephen C., Kenneth E. Durley and Michael J. McHugh. 1968. Forecasts of 1968 pink salmon runs, Southeastern Alaska. Alaska Department of Fish and Game Informational Leaflet No. 118. 17 p.

APPENDIX A. KODIAK AREA INDEXED ESCAPEMENT (37 STREAMS) 1962-1970.

Index streams	1962	1963	1964	1965	1966	1967	1968	1969	1970
Portage Lake**	27,300	3,200	37,000	10,000	20,000	3,000	6,000	25,000*	15,000*
Paramanof-304**	20,000	700	18,000	2,200	17,000	200	27,000	2,900*	15,000*
Malina	60,000	0	35,000	200	19,000	--	13,000	1,000*	31,000*
Afognak**	75,000	2,000	45,000	900	26,000	1,000	10,000	12,000*	25,000*
Marka	65,000	4,000	22,000	3,500	35,000	2,500	15,000	12,000*	120,000*
Danger**	50,000	2,500	11,000	2,000	25,000	5,000	15,000	7,600*	45,000*
Elbow**	15,000	5,000	11,000	3,200	13,000	11,000	11,000	9,000	10,000*
Kizhuyak-365	8,000	5,000	5,000	4,300	4,300	12,000	2,000	15,000	11,000*
Bauman's**	17,000	--	8,000	1,800	9,000	4,200	6,000	7,000	7,000*
Terror**	45,000	35,000	40,000	12,000	85,000	35,000	45,000	55,000	40,000*
Uganik**	100,000	45,000	75,000	12,000	80,000	40,000	21,000	60,000	80,000*
Little	45,000	--	50,000	--	37,000	--	45,000	--	75,000*
Zachar**	25,000	89,000	24,000	8,000	16,000	2,700	15,000	17,000	30,000*
Brown's	96,000	200	65,000	300	24,000	300	35,000	2,600*	37,000*
Uyak**	65,000	40,000	100,000	60,000	40,000	75,000	35,000	95,000	69,000*
Karluk	350,000	--	525,000	--	225,000	--	140,000	--	210,000*
Sturgeon	35,800	--	140,000	--	90,000	--	30,000	--	48,000*
Red	1,100,000	--	425,000	--	175,000	--	300,000	--	800,000*
Dog Salmon**	83,000	60,000	50,000	36,000	21,000	11,000	12,000	45,000	25,000*
Narrows**	18,000	1,700	4,200	2,500	600	3,500	2,800	6,000*	3,000*
Horse Marine	3,000	0	2,600	--	800	300	2,400	--	500*
Deadman**	25,000	22,000	18,000	30,000	12,000	70,000	20,000	65,000	65,000*
Sulua	12,000	16,000	8,000	7,000	6,000	7,000	6,000	4,500	5,000*
Old Tom's	0	--	--	200	300	2,300	5,500	3,200	10,000*
Humpy**	300,000	115,000	80,000	175,000	36,000	60,000	120,000	55,000	110,000*
Seven**	128,000	40,000	10,000	60,000	16,000	25,000	55,000	33,000	100,000*
Kaiugnak**	34,000	7,000	10,000	8,500	10,000	8,000	10,000	4,000	29,000*
Barling**	40,000	8,000	60,000	3,500	20,000	12,000	28,000	20,000	48,000*
Midway	6,000	5,000	--	1,000	4,500	100	6,000	1,900*	14,000*
Shearwater	500	50	--	50	900	500	500	60	3,500*
Kiliuda-207**	18,700	5,000	17,000	1,100	9,000	1,700	5,000	2,000	8,000*
Eagle Harbor	26,700	600	13,000	1,000	8,000	3,000	10,000	1,200	19,000*
Saltery**	70,000	35,000	28,000	20,000	17,000	36,000	5,000	50,000	15,000*
Miam	37,000	--	--	--	22,000	--	42,000	--	57,000*
Sid Old's**	70,000	10,000	30,000	6,000	35,000	19,000	55,000	36,000	63,000*
American**	21,000	11,000	25,000	9,000	24,000	14,000	25,000	70,000	84,000*
Buskin**	209,000*	7,200*	93,000*	25,600*	20,000*	28,000*	42,000*	66,500*	44,250*
	3,301,000	575,150	2,084,800	506,850	1,203,400	493,300	1,223,200	784,460	2,371,250

* ADF&G count, all others FRI

** Denotes odd year pre-emergent fry sampling stream

APPENDIX B. KODIAK AREA PINK SALMON RETURNS - 1962-1970

District	INDEXED ESCAPEMENT (37 STREAMS) 1962	1963	1964	1965	1966
Afognak	320,300	22,400	184,000	26,300	159,300
Uganik and Uyak	393,000	209,200	362,000	94,100	291,000
Karluk, Sturgeon and Red River	1,485,800	0	1,090,000	0	490,000
Alitak	441,000	214,700	162,800	250,700	76,700
General (Eastside)	660,900	128,800	286,000	135,700	186,400
Total	3,301,000	575,100	2,084,800	506,800	1,203,400

	CATCH 1962	1963	1964	1965	1966
Afognak	2,281,000	648,000	1,402,000	138,000	3,200,000
Uganik and Uyak	1,676,000	873,000	2,526,000	643,000	3,705,000
Karluk, Sturgeon and Red River	3,990,000	21,000	3,693,000	19,000	777,000
Alitak	1,887,000	1,527,000	1,419,000	1,136,000	433,000
General (Eastside)	3,154,000	2,413,000	2,217,000	887,000	2,162,000
Total	12,988,000	5,482,000	11,257,000	2,823,000	10,277,000

	TOTAL RETURN - CATCH AND ESCAPEMENT INDEX 1962	1963	1964	1965	1966
Afognak	2,601,300	670,400	1,586,000	164,300	3,359,300
Uganik and Uyak	2,069,000	1,082,200	2,888,000	737,100	3,996,000
Karluk, Sturgeon and Red River	5,475,800	21,000	4,783,000	19,000	1,267,000
Alitak	2,328,000	1,741,700	1,581,800	1,386,700	509,700
General (Eastside)	3,814,900	2,541,800	2,503,000	1,022,700	2,348,400
Total	16,289,000	6,057,100	13,341,800	3,329,800	11,480,400

APPENDIX B. (CONTINUED) KODIAK AREA PINK SALMON RETURNS - 1962-1970

District	INDEXED ESCAPEMENT (37 STREAMS) 1967	1968	1969	1970
Afognak	34,700	99,000	84,500	272,000
Uganik and Uyak	157,200	202,000	236,600	338,000
Karluk, Sturgeon and Red River	0	470,000	0	1,058,000
Alitak	154,100	168,700	178,700	218,500
General (Eastside)	147,300	283,500	284,700	484,750
Total	493,300	1,223,200	784,500	2,371,250

	CATCH 1967	1968	1969	1970 1/
Afognak	28,000	1,315,000	413,000	1,453,000
Uganik and Uyak	22,000	1,951,000	608,000	1,978,000
Karluk, Sturgeon and Red River	6,000	1,495,000	30,000	1,245,000
Alitak	85,000	1,046,000	3,754,000	950,000
General (Eastside)	45,000	2,583,000	7,615,000	6,110,000
Total	186,000	8,390,000	12,420,000	11,736,000

	TOTAL RETURN - CATCH AND ESCAPEMENT INDEX 1967	1968	1969	1970
Afognak	62,700	1,414,000	497,500	1,725,000
Uganik and Uyak	179,200	2,153,000	844,600	2,316,000
Karluk, Sturgeon and Red River	6,000	1,965,000	30,000	2,303,000
Alitak	239,100	1,214,700	3,932,700	1,168,500
General (Eastside)	192,300	2,866,500	7,899,700	6,594,750
Total	679,300	9,613,200	13,204,500	14,107,250

1/ All 1970 catch figures are preliminary.

APPENDIX C. KODIAK AREA PINK SALMON PRE-EMERGENT FRY SAMPLING SUMMARY, 1963-1970

STREAM	1963		1965		1966		1967		1968		1969		1970	
	No.2ft² Samples	No. Fry	No.2ft² Samples	No. Fry	No.2ft² Samples	No. Fry	No.2ft² Samples	No. Fry	No.2ft² Samples	No. Fry	No.2ft² Samples	No. Fry	No.2ft² Samples	No. Fry
Portage Lake 1/													30	1215
Portage Lake 2/	50	4710	50	1041	50	1280	50	2731	50	3372	50	1934	50	5146
Paramanof-304	50	498	71	5389			65	4284	65	0	59	2484	50	26
Malina							90	4732			80	10821		
Afognak 1/			45	80	40	0	85	1060	40	0	70	541	70	55
Afognak 2/	60	2612												
Marka							95	3727			90	2846		
Danger	80	2513	80	3971			65	4913	57	1668	60	4862	60	347
Elbow	35	732	45	1501	55	103	50	1017	50	626	50	3665	50	854
Bauman's	50	709	35	3184	30	680	40	494	40	2628	40	4277	40	1115
Terror	70	628	70	1139	100	23	75	1045	70	53	85	1080	70	92
Uganik	70	1964	70	3743	65	214	70	326	80	1433	70	2648	80	147
Little							100	6718			90	4891		
Zachar	30	718	50	411	50	0	60	106	60	0	60	911	60	0
Brown's	20	565	85	1104			70	2432			70	3868		
Uyak			80	2237	75	829	80	1545	85	2766	80	3286	71	4196
Karluk							120	323			135	2326		
Sturgeon							110	273			100	29		
Red	150	7608	180	3449			140	5081			150	16608		
Frazer	150	4326	125	606			70	70						
Dog Salmon 1/					110	1537			90	4257			90	812
Dog Salmon 2/							60	3585			60	10724		
Narrows	40	2771			45	646	50	331	50	2092	50	1602	50	1142
Deadman					60	3162	80	2063	80	5994	80	8822	80	5085
Humpy 1/							60	47	90	1516	60	83	60	291
Humpy 2/			105	0	60	57	60	2703	60	6330	40	1206	60	1377
Seven (upper fork)	50	1283	75	1196	80	882	50	425	75	5226	60	5668	75	2024
Seven (lower fork)					55	2004	50	2621	70	5429	70	2558	70	6180
Kaiugnak	30	2464	51	3712	50	561	50	4686	61	10295	50	7451	50	635
Barling									50	124	50	114	60	401
Kiliuda-207							60	1283			50	1073	50	757
Saltery	70	685	180	312	90	611	90	113	85	1205	80	98	80	503
Hurst											60	3422	60	1117
Portage (Miam)							60	1202			65	191		
Sid Old's	154	2513	115	4423	80	22	80	1783	90	1699	80	1549	80	2695
American	150	3381	115	3750	90	247	100	2148	95	1508	85	6055	80	2243
Buskin	75	5112	120	7681	120	1586	90	3738	90	192	90	7862	90	773

1/ Upstream Sampling Area
2/ Downstream Sampling Area

APPENDIX D, KODIAK AREA PINK SALMON PRE-EMERGENT FRY SAMPLING DENSITIES, 1963-1970

STREAM	1963 Density $0.1m^2$	1965 Density $0.1m^2$	1966 Density $0.1m^2$	1967 Density $0.1m^2$	1968 Density $0.1m^2$	1969 Density $0.1m^2$	1970 Density $0.1m^2$
Portage Lake (upstream)							21.79
Portage Lake (downstream)	50.68	11.20	13.77	29.39	36.28	20.81	55.37
Paramanof-304	5.36	40.83		35.16	0.00	22.65	0.28
Malina				28.29		72.77	
Afognak (upstream)		1.08	0.00	6.71	0.00	4.15	0.42
Afognak (downstream)	23.42						
Marka				21.11		17.01	
Danger	16.90	26.71		40.66	15.74	43.60	3.11
Elbow	11.25	17.95	1.01	10.94	6.74	39.44	9.19
Bauman's	7.63	48.94	12.19	6.64	35.35	57.52	15.00
Terror	4.83	8.76	0.12	7.50	0.41	6.84	0.71
Uganik	15.10	28.77	1.77	2.51	9.64	20.35	0.99
Little				36.14		29.23	
Zachar	12.88	4.42	0.00	0.95	0.00	8.17	0.00
Brown's	15.20	6.98		18.69		29.96	
Uyak		15.04	5.95	10.39	17.51	22.10	31.79
Karluk				1.45		9.27	
Sturgeon				1.34		0.16	
Red	27.29	10.31		19.53		59.57	
Frazer	15.52	2.61		0.54			
Dog Salmon (upstream)			7.52		25.45		4.85
Dog Salmon (downstream)				32.15		96.16	
Narrows	37.27		7.73	3.56	22.51	17.24	12.29
Deadman			28.35	13.87	40.31	59.33	34.20
Humpy (upstream)				0.42	9.06	0.74	2.61
Humpy (downstream)		0.00	0.51	24.24	56.76	16.22	12.37
Seven (upper fork)	13.80	8.58	5.93	4.57	37.49	50.82	14.49
Seven (lower fork)			19.60	28.20	41.73	19.66	47.49
Kaiugnak	44.19	39.16	6.04	50.42	90.80	80.17	6.83
Barling					1.33	1.23	3.60
Kiliuda-207				11.51		11.55	8.15
Saltery	5.26	2.10	3.65	0.68	7.63	0.66	3.38
Hurst						30.68	10.02
Portage (Miam)				10.79		1.58	
Sid Old's	8.78	20.69	0.15	11.99	10.16	10.42	18.12
American	12.13	17.54	1.48	11.56	8.54	38.32	14.02
Buskin	36.67	34.44	7.11	22.35	1.15	47.00	4.62